METAL CASTING

Project Fact Sheet

IMPROVEMENT OF THE LOST FOAM CASTING PROCESS

IMPROVED LOST FOAM CASTING REDUCES ENERGY USE, WASTE, AND EMISSIONS, WHILE LOWERING PRODUCT DEFECTS AND COSTS

Benefits

- Offers potential annual savings of 250 billion Btu of natural gas and electricity per installation producing 462,000 heads and blocks a year
- Offers potential annual savings of 2.25 trillion Btu by 2010
- Improves product quality 5% to 8% over conventional lost foam casting and significantly reduces scrap rates
- Reduces harmful incinerator emissions and sand waste 2.2. to 3.5 tons a year
- Reduces costs for polystyrene beads, glue, coating, sand, aluminum, cleaning media, and labor by $900,000 to $1.5 million annually

Applications

This technology benefits the metal casting and aluminum industries.

Project Partners

NICE³ Program
Washington, DC

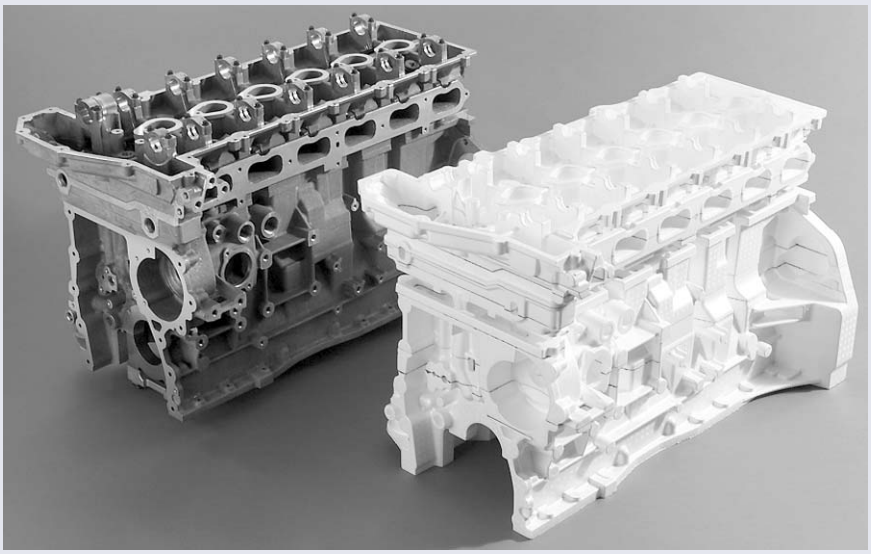
New York State Energy Research and Development Authority
Albany, NY

General Motors Corporation
Pontiac, MI

Casting is an energy-intensive manufacturing process within the metal casting and aluminum industries, requiring natural gas to melt aluminum and electricity to run equipment. The higher-than-acceptable faults and scrap rates in the lost foam casting process for the complex L61 engine result from the inability to control and measure refractory coating thickness and to control particle size and shape of unbonded sand. Replacing or re-melting defective castings adds to overall energy costs, emissions, and use of resources.

General Motors is developing tools to precisely measure dried coating thickness and pore size distribution, more accurately measure the size and shape of sand used in casting, and better understand the rheology of coatings. These improvements should dramatically enhance casting quality by 5% to 8%, thus reducing energy use, waste, and emissions.

CYLINDER HEAD AND BLOCK WITH FOAM CASTING



General Motors is demonstrating an improved aluminum cast molding process for their L61 engine block and head that uses accurate methods of measuring refractory coating thickness and other key quality factors that will improve overall production efficiency, and lower production costs and emissions.

Project Description

Goal: Demonstrate lost foam casting process improvements that significantly reduce aluminum and sand scrap rates during production of the highly complex General Motors L61 engine.

General Motors will be using a sophisticated sampling system to improve the lost foam casting process. A rotational rheometer will quantify reformation and flow properties and promote more uniform coating thickness in critical areas of foam parts. Yield point, thixotropic loop size and shape, and creep and recovery data will be collected to develop an even coating layer. A tool using digital imaging will provide essential particle size and shape information on unbonded sand, allowing variations in the sand matrix surrounding the expanded polystyrene beads used with the sand matrix to be measured and minimized.

General Motors will demonstrate these improvements with assistance from the New York State Energy Research and Development Authority and the NICE^3 Program of the U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Acquire equipment for characterizing refractory slurry and sand.
- Test, use, and analyze rheology, coating thickness, permeability, and pore size measurement data for acceptable process control ranges.

Economics and Commercial Potential

Lost foam casting uses almost a quarter less energy and a third less molten metal than conventional casting and enables joining of several components within a single casting, saving downstream machining and assembly. However, it currently results in excessive scrap rates.

A 5% to 8% improvement in product quality is expected with the improved process. A plant producing 2,100 L61 heads and blocks a day for 220 days a year should reduce energy costs by $604,000 to $967,000 annually. The 7% reduction in scrap should expand application of lost foam casting from the current 36 foundries to all of the 2,900 foundries in the United States. This technology could save 250 billion Btu of natural gas and electricity annually for each upgraded installation that produce 462,000 head and block castings.

Currently, 36 installations produce 17 million cars a year. An ultimate market share of 80% for the improved process is reasonable. First sales of the technology are expected in 2004. Based on 24% new market penetration by 2010, annual savings could be 2.25 trillion Btu from 9 installations. Market penetration of 62% by 2020 will save 6.9 trillion Btu annually from 27 installations.

NICE^3 – National Industrial Competitiveness through Energy, Environment, and Economics:
An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry.
This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to $525,000. Grants fund up to 50% of total project cost for up to 3 years.

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